Prognostic value of automatic acquired biomarkers using artificial intelligence in 18F-Choline PET/CT in high risk prostate cancer.

P Borrelli[1], H Kjölhede[2], O Enqvist[3], E Polymeri[4], M Ohlsson[5], E Trägårdh[6], L Edenbrandt[1]

[1]Department of Clinical Physiology, Sahlgrenska University Hospital, Gothenburg, Sweden; [2]Department of Urology, Sahlgrenska Academy, Gothenburg University; [3]Department of Electrical Engineering, Chalmers University of Technology, Gothenburg, Sweden; [4]Department of Radiology, Sahlgrenska University Hospital, Gothenburg, Sweden; [5]Center for Applied Intelligent Systems Research, Halmstad, Sweden; [6]Department of Translational Medicine, Lund University, Malmö, Sweden;

ABSTRACT

Biomarkers are still not routinely used in PET/CT explorations and one of the motives could be that automated quantitative PET/CT assessments are often lacking.

Until now, deep learning in prostatic malignancies has been almost exclusively focused on MR explorations

The aim of this study is to explore the potential clinical relevance of deep learning methods for automated quantification of 18F-choline uptake in the prostate gland in high-risk prostate cancer patients.

METHODS

Deep Learning Method
Automated segmentation method (PET and CT images), fully convolutional neural network (CNN).

Training dataset
150 patients, prostate and urinary bladder manually segmented in PET and CT scans.

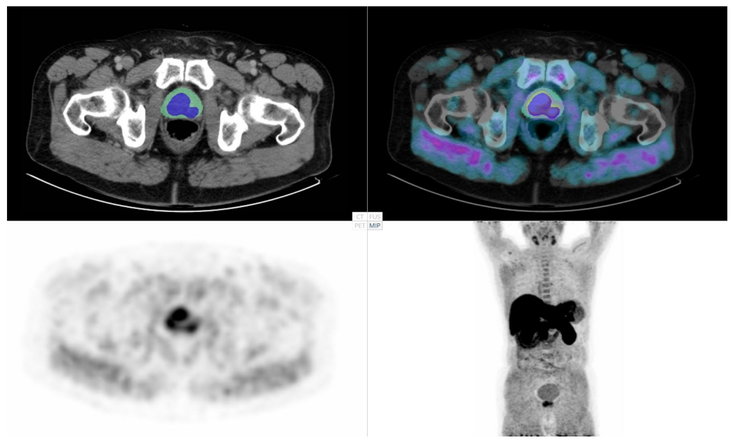
CNN worked directly on the 3D images producing segmentation of the prostate gland, prostate tumor (SUVmax >2.65) and urinary bladder (analysis time < 1 minute). (fig 1)

Study group
77 prostate cancer patients: newly diagnosed, biopsy verified, high risk prostate cancer (Gleason >8) and/or (PSA >20).

18F-Choline PET/CT prior to radical prostatectomy.

Variables studied
- Prostate volume;
- Lesion volume;
- SUVmax;
- Total lesion uptake (TLU): defined as the product SUVmean x lesion volume.

Fig. 1



Automatic segmentation of prostate (green) and pathological uptake (blue).

RESULTS

Table 1

Variable	C-index	95% CI	Hazard ratio	95% CI	p-val
Clinical					
Age	0.61	0.46 - 0.76	0.97	0.88 - 1.06	0.50
PSA	0.65	0.50 - 0.79	1.02	1.00 - 1.05	0.034
Gleason	0.69	0.47 - 0.92	1.70	0.87 - 3.33	0.12
T stage	0.74	0.51 - 0.97	2.10	0.79 – 5.65	0.14
PET/CT					
Prostate Vol	0.73	0.61 - 0.85	1.03	1.00 - 1.06	0.016
Lesion Vol	0.76	0.62 - 0.91	1.05	1.02 - 1.08	0.001
TLU	0.73	0.58 - 0.88	2.37	1.22 – 4.59	0.011
SUVmax	0.58	0.44 - 0.72	1.14	0.92 - 1.41	0.24

C-index and Univariate Cox proportional hazards regression model.

RESULTS

1. 12 out of 77 patients died during follow-up.
   1. Median survival 12 patients: 4.9 years (range 1.7 – 7)
   2. Median survival remaining patients: 6.6 years (range 1.8-8.5)
2. TLU, prostate volume, lesion volume and PSA value were significantly associated with prostate cancer specific survival (table 1).
3. SUVmax, age, T stage and Gleason score were not associated with prostate cancer specific survival (table 1).

CONCLUSIONS

Automated deep learning-based measurements of 18F-choline uptake in the prostate gland were significantly associated with prostate cancer specific survival in patients with hormone-naive prostate cancer. This type of deep learning-based methods could be applied to other prostate cancer PET tracers as well, for example PSMA.

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pablo.borrelli@vgregion.se

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